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(54) HOME IMPROVEMENT STORE AUTONOMOUS WORKHORSE

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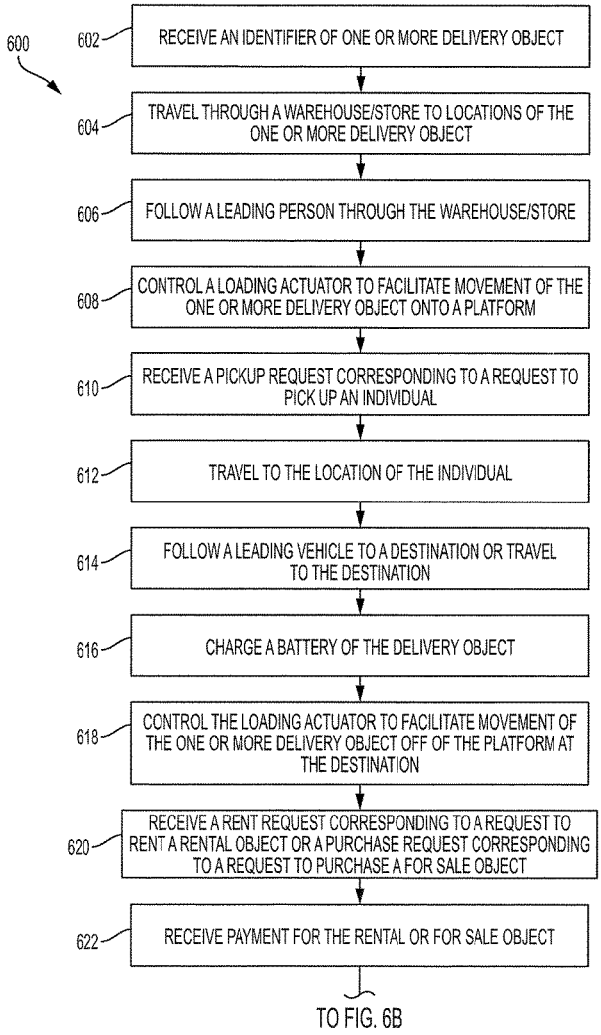
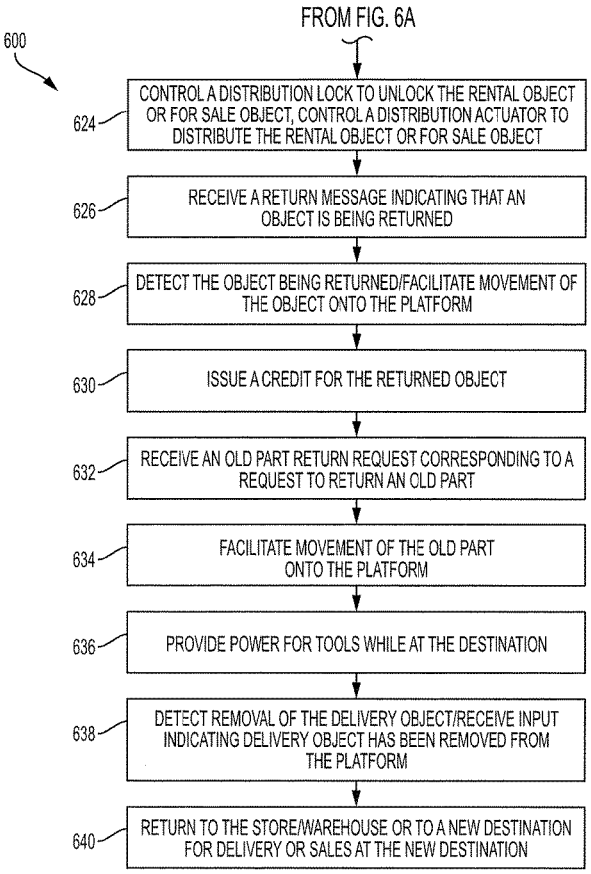
(57) **ABSTRACT**

An autonomous workhorse vehicle includes a main body including a platform to support a plurality of objects, a tracking sensor to detect a location of the main body relative to a leading vehicle, and an input/output port to receive an identifier of the leading vehicle. The autonomous workhorse vehicle further includes a power source to provide power to propel the main body, a steering actuator designed to adjust an orientation of the main body, and an ECU. The ECU is designed to receive the identifier of the leading vehicle. The ECU is further designed to determine a following time to begin following the leading vehicle. The ECU is further designed to control the power source and the steering actuator to move the main body to follow the leading vehicle at the following time based on the detected location of the main body relative to the leading vehicle.





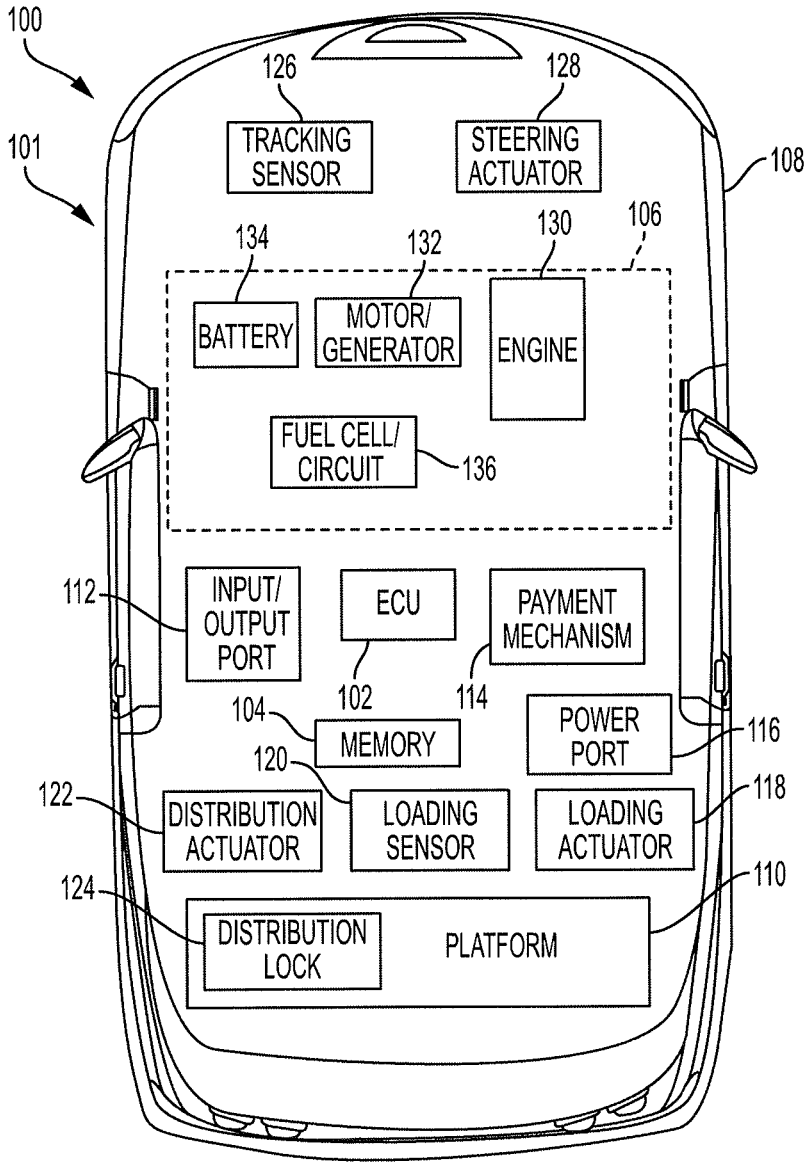

100
101
126
TRACKING SENSOR
128
STEERING ACTUATOR
108
106
130
134
132
BATTERY
MOTOR/ GENERATOR
ENGINE
FUEL CELL/ CIRCUIT
136
112
INPUT/ OUTPUT PORT
ECU
PAYMENT MECHANISM
102
114
104
MEMORY
POWER PORT
116
120
122
DISTRIBUTION ACTUATOR
LOADING SENSOR
LOADING ACTUATOR
118
124
DISTRIBUTION LOCK
PLATFORM
110

FIG. 1

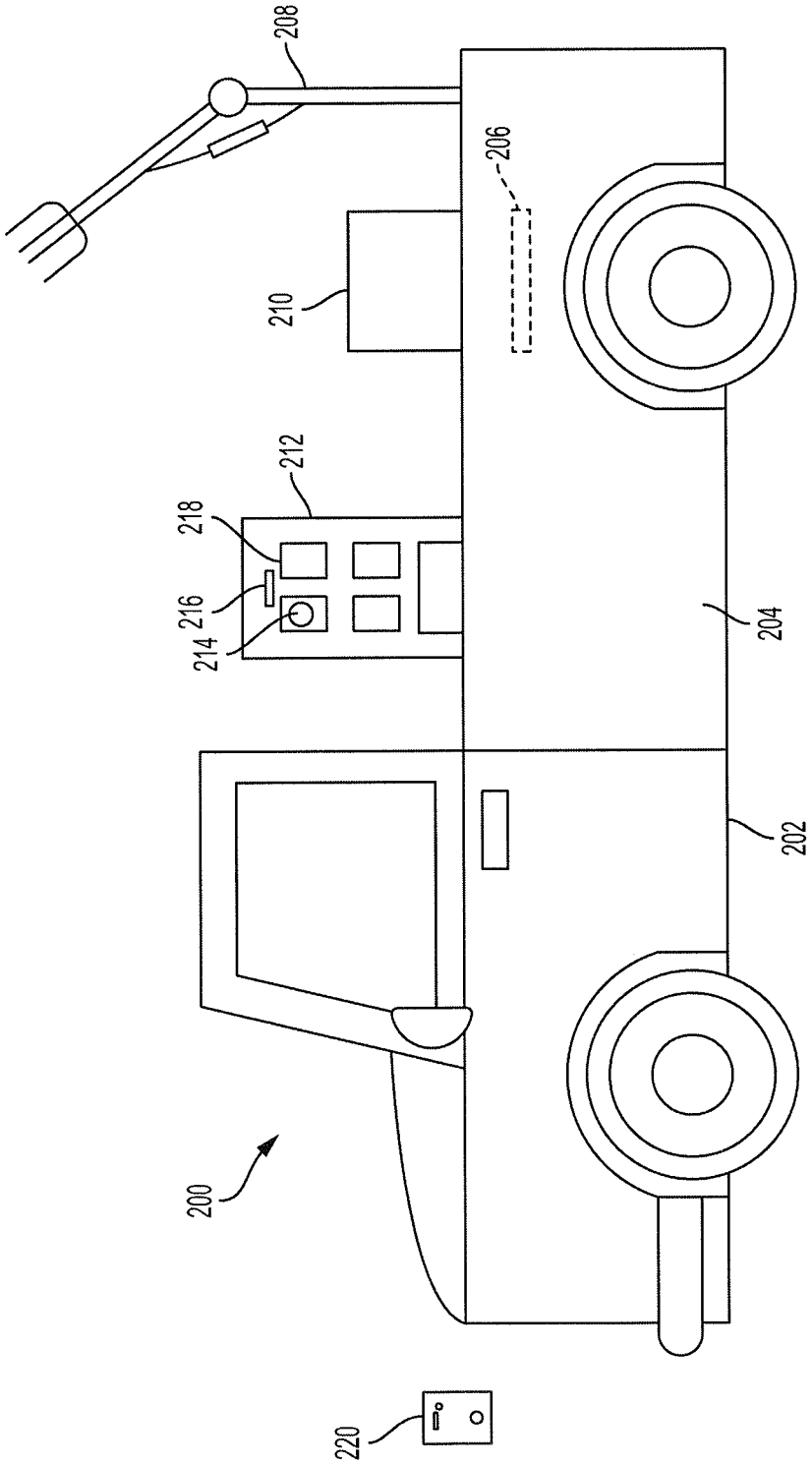


FIG. 2

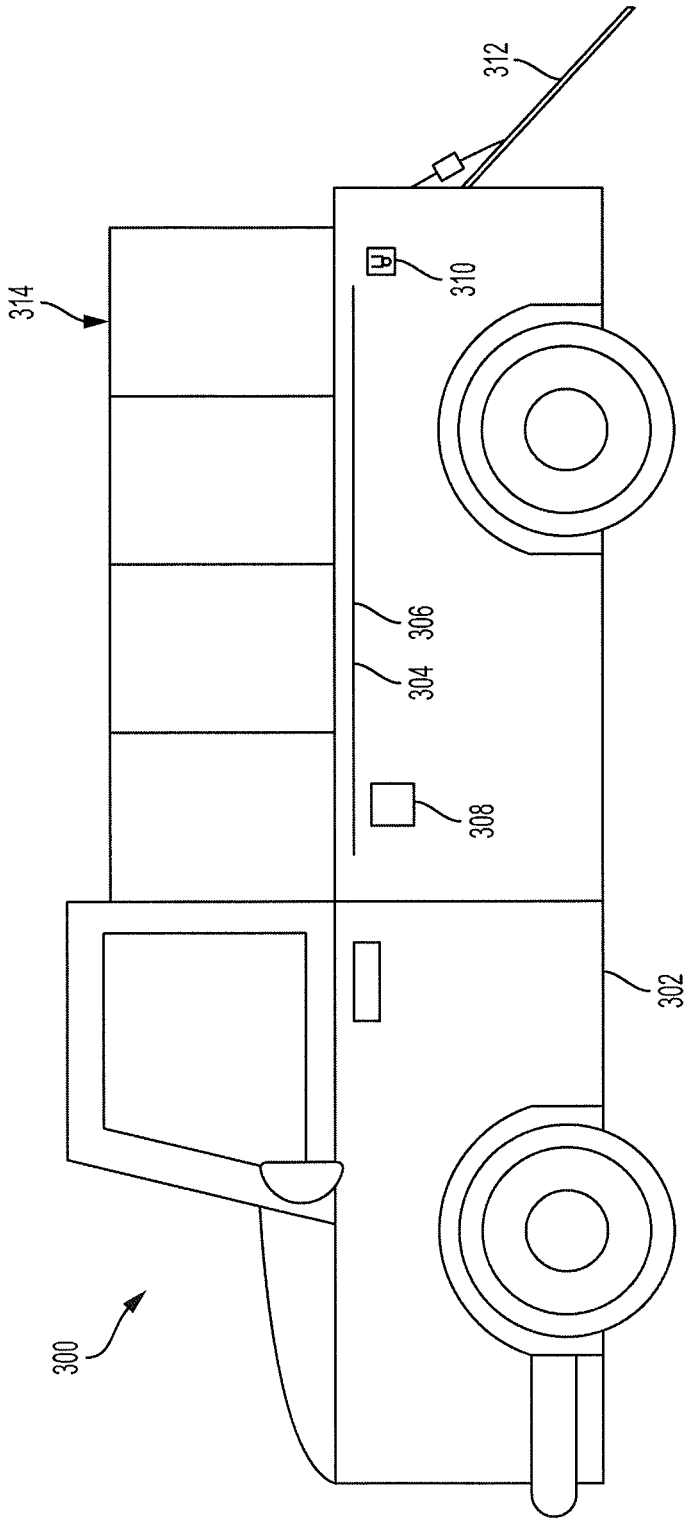


FIG. 3

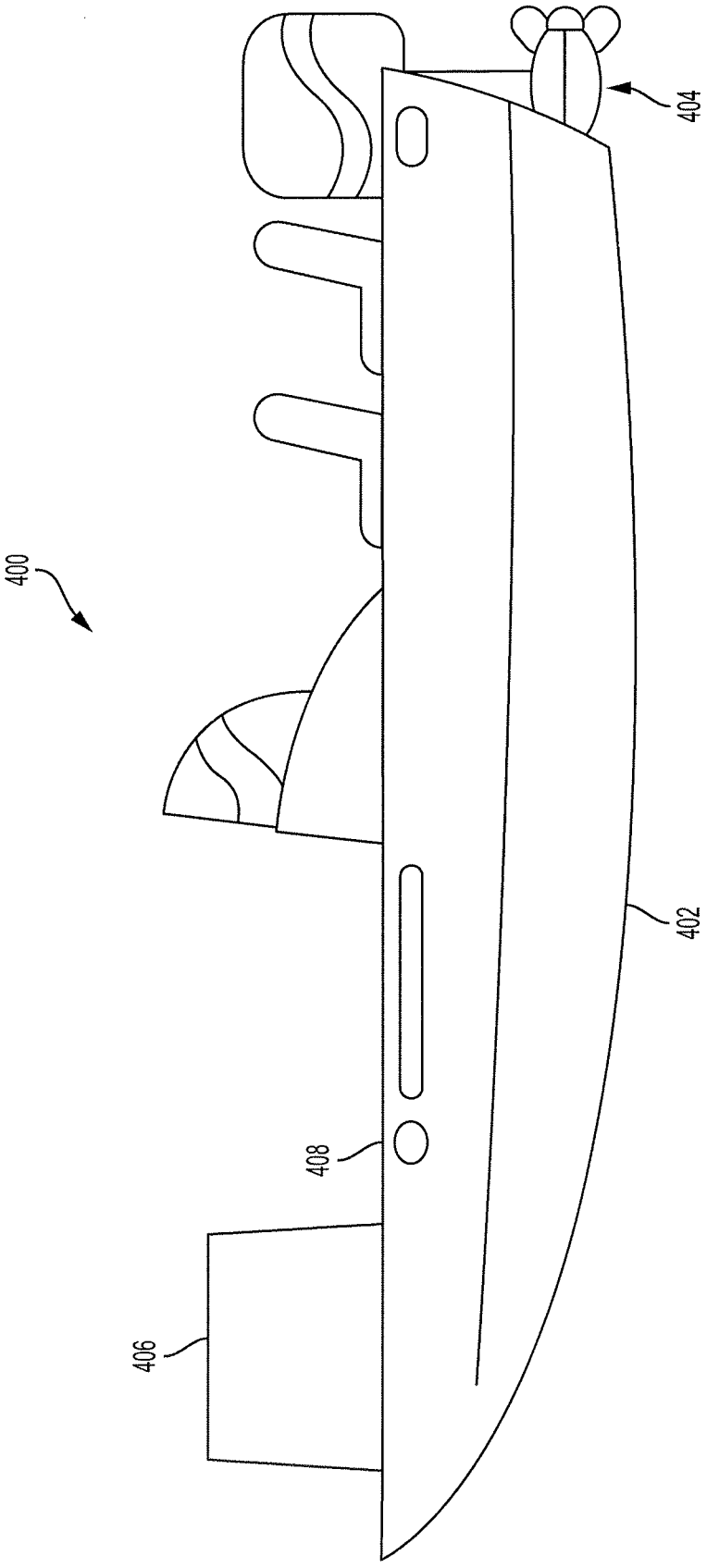


FIG. 4

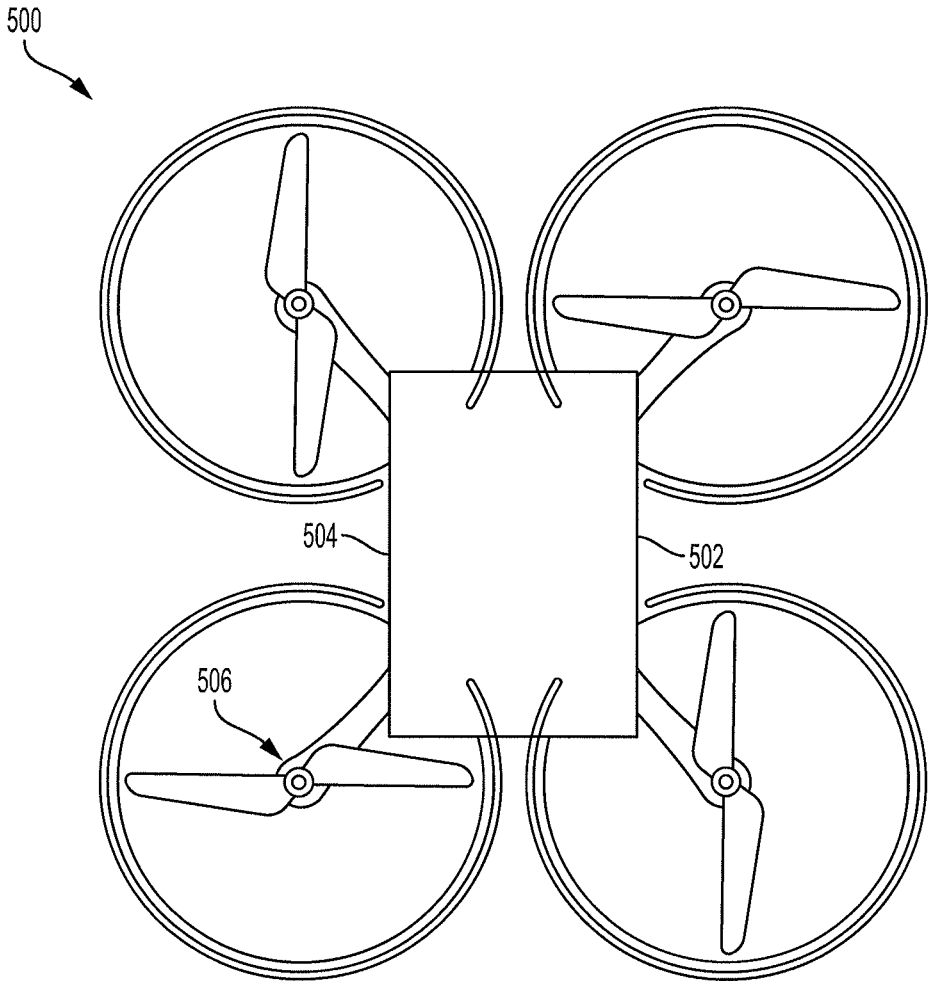


FIG. 5

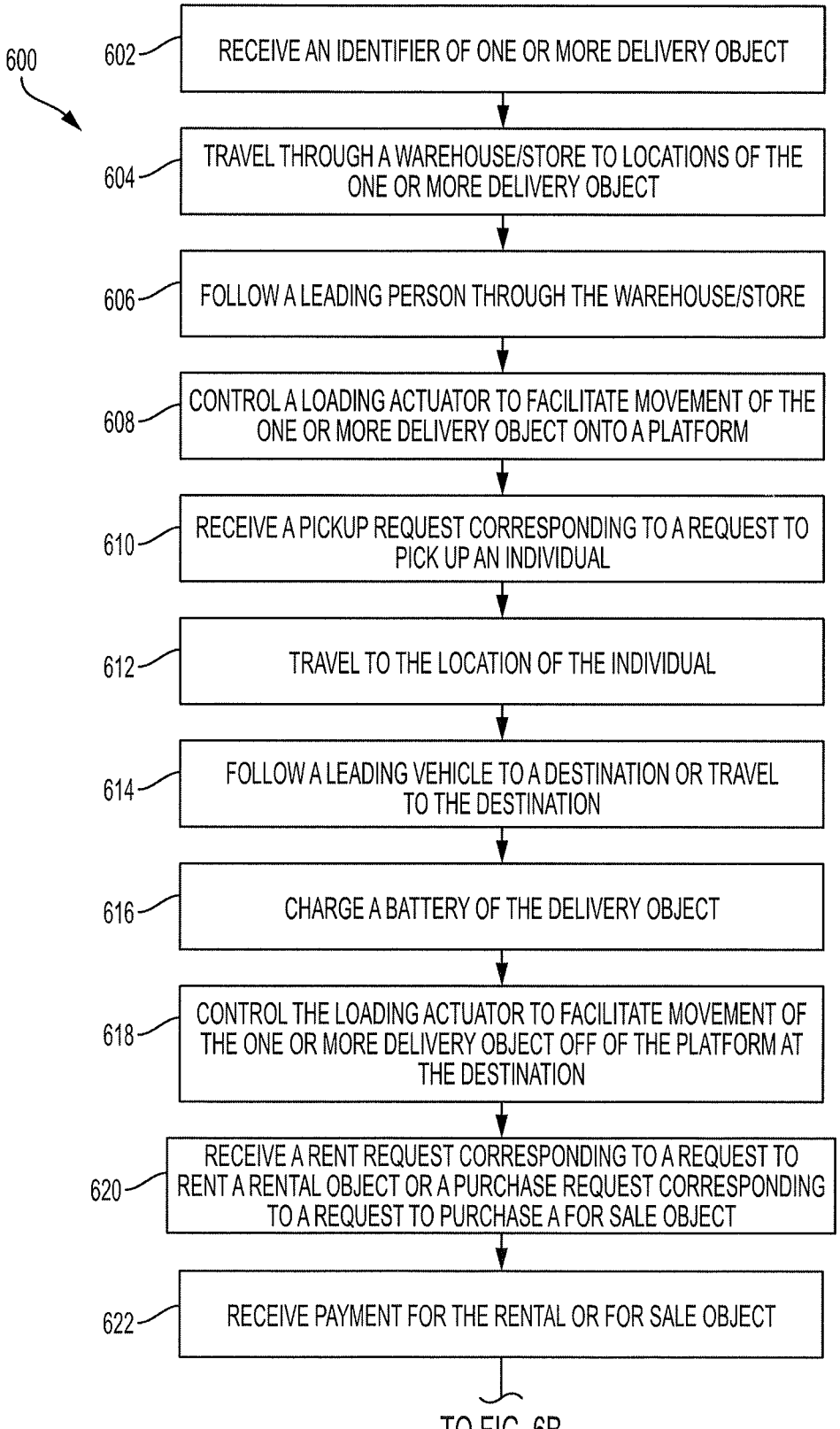

600
602
RECEIVE AN IDENTIFIER OF ONE OR MORE DELIVERY OBJECT
604
TRAVEL THROUGH A WAREHOUSE/STORE TO LOCATIONS OF THE ONE OR MORE DELIVERY OBJECT
606
FOLLOW A LEADING PERSON THROUGH THE WAREHOUSE/STORE
608
CONTROL A LOADING ACTUATOR TO FACILITATE MOVEMENT OF THE ONE OR MORE DELIVERY OBJECT ONTO A PLATFORM
610
RECEIVE A PICKUP REQUEST CORRESPONDING TO A REQUEST TO PICK UP AN INDIVIDUAL
612
TRAVEL TO THE LOCATION OF THE INDIVIDUAL
614
FOLLOW A LEADING VEHICLE TO A DESTINATION OR TRAVEL TO THE DESTINATION
616
CHARGE A BATTERY OF THE DELIVERY OBJECT
618
CONTROL THE LOADING ACTUATOR TO FACILITATE MOVEMENT OF THE ONE OR MORE DELIVERY OBJECT OFF OF THE PLATFORM AT THE DESTINATION
620
RECEIVE A RENT REQUEST CORRESPONDING TO A REQUEST TO RENT A RENTAL OBJECT OR A PURCHASE REQUEST CORRESPONDING TO A REQUEST TO PURCHASE A FOR SALE OBJECT
622
RECEIVE PAYMENT FOR THE RENTAL OR FOR SALE OBJECT
TO FIG. 6B

FIG. 6A

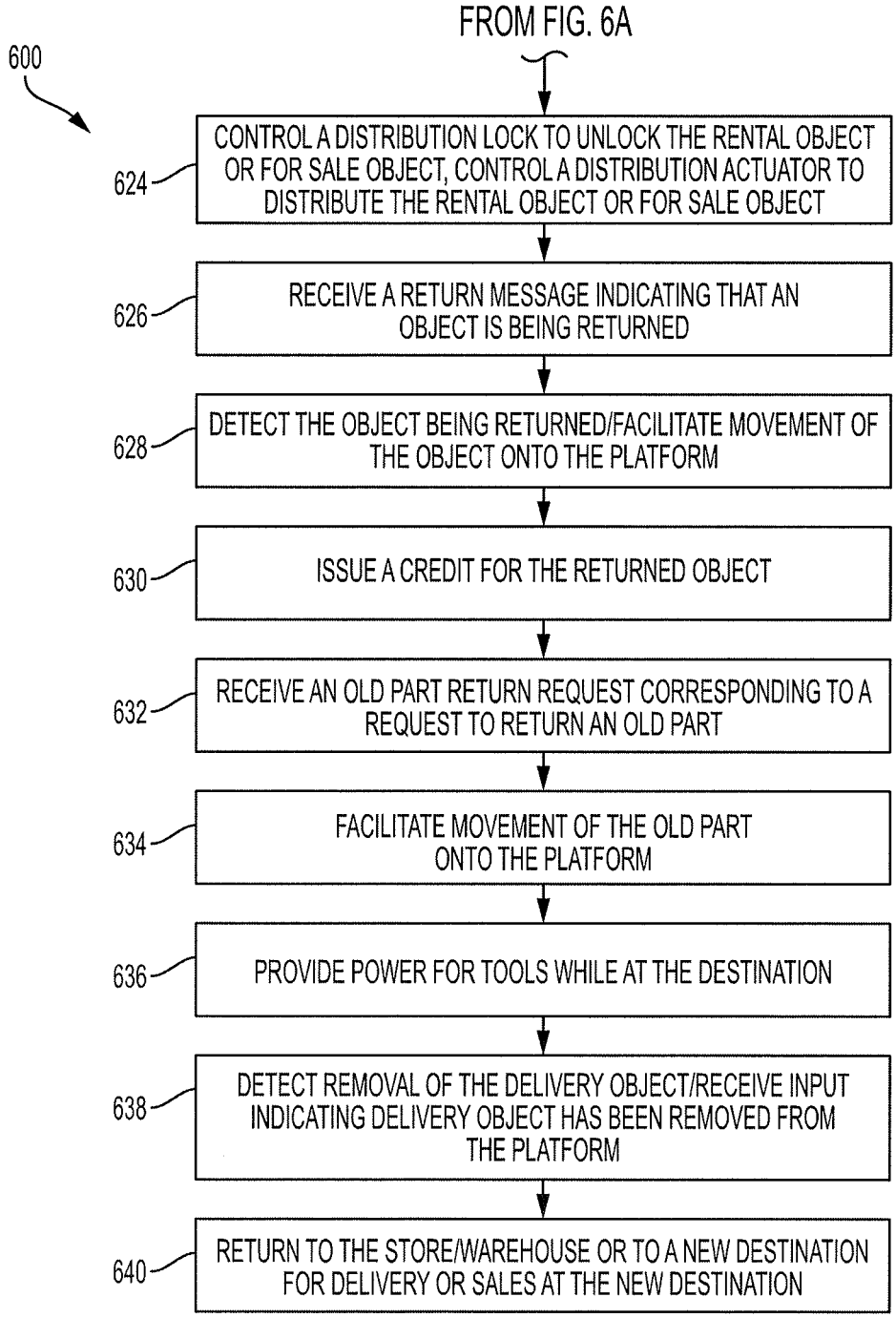

FROM FIG. 6A
600
624
CONTROL A DISTRIBUTION LOCK TO UNLOCK THE RENTAL OBJECT OR FOR SALE OBJECT, CONTROL A DISTRIBUTION ACTUATOR TO DISTRIBUTE THE RENTAL OBJECT OR FOR SALE OBJECT
626
RECEIVE A RETURN MESSAGE INDICATING THAT AN OBJECT IS BEING RETURNED
628
DETECT THE OBJECT BEING RETURNED/FACILITATE MOVEMENT OF THE OBJECT ONTO THE PLATFORM
630
ISSUE A CREDIT FOR THE RETURNED OBJECT
632
RECEIVE AN OLD PART RETURN REQUEST CORRESPONDING TO A REQUEST TO RETURN AN OLD PART
634
FACILITATE MOVEMENT OF THE OLD PART ONTO THE PLATFORM
636
PROVIDE POWER FOR TOOLS WHILE AT THE DESTINATION
638
DETECT REMOVAL OF THE DELIVERY OBJECT/RECEIVE INPUT INDICATING DELIVERY OBJECT HAS BEEN REMOVED FROM THE PLATFORM
640
RETURN TO THE STORE/WAREHOUSE OR TO A NEW DESTINATION FOR DELIVERY OR SALES AT THE NEW DESTINATION

FIG. 6B

HOME IMPROVEMENT STORE AUTONOMOUS WORKHORSE

BACKGROUND

1. Field

[0001] The present disclosure relates to systems and methods for providing a platform for autonomous delivery of objects purchased at a store or purchased remotely.

2. Description of the Related Art

[0002] Many home improvement stores have trucks or other vehicles available for rent to their customers. These trucks may be rented if a user has purchased too many goods to fit in their personal vehicles, purchased large goods, or does not wish to load the goods into their personal vehicles. Such a system may be undesirable because it results in wasted time of the individual as they will need to drive the rented vehicle to their house, unload the goods, then return the rented vehicle, and then drive their personal vehicle back home. Additionally, if a user purchases incorrect goods, they must return to the store with the old goods, purchase new goods, and again drive the rented vehicle to their house. Also, if a user is replacing a large appliance with a new appliance, they must also make plans to have the old appliance removed and taken to a return site, a recycle site, or a dump site. This undesirably produces many steps that a user must take to replace a large appliance. Also, if a user purchases a large appliance, they may be unable to load and unload the appliance themselves, causing them to have to hire help. These are all inefficient, costly, and time-consuming tasks.

[0003] Therefore, systems and methods for autonomous transport and delivery of purchased goods is desirable.

SUMMARY

[0004] Described herein is an autonomous workhorse vehicle. The autonomous workhorse vehicle includes a main body including a platform designed to support a plurality of objects. The autonomous workhorse vehicle further includes a tracking sensor designed to detect a location of the main body relative to a leading vehicle. The autonomous workhorse vehicle further includes an input/output port designed to receive an identifier of the leading vehicle. The autonomous workhorse vehicle further includes a power source designed to provide power to propel the main body. The autonomous workhorse vehicle further includes a steering actuator designed to adjust an orientation of the main body. The autonomous workhorse vehicle further includes an electronic control unit (ECU) coupled to the tracking sensor, the input/output port, the power source, and the steering actuator. The ECU is designed to receive the identifier of the leading vehicle. The ECU is further designed to determine a following time to begin following the leading vehicle. The ECU is further designed to control the power source and the steering actuator to move the main body to follow the leading vehicle at the following time based on the detected location of the main body relative to the leading vehicle.

[0005] Also disclosed is another autonomous workhorse vehicle. The autonomous workhorse vehicle includes a main body including a platform designed to support a plurality of objects. The autonomous workhorse vehicle further includes an input/output port designed to receive an identifier of a delivery object to be delivered from a remote device and a delivery address corresponding to an address at which the delivery object is to be delivered. The autonomous workhorse vehicle further includes a power source designed to provide power to propel the main body. The autonomous workhorse vehicle further includes a steering actuator designed to adjust an orientation of the main body. The autonomous workhorse vehicle further includes a loading actuator designed to facilitate movement of the delivery object onto the platform. The autonomous workhorse vehicle further includes an electronic control unit (ECU) coupled to the input/output port, the power source, the steering actuator, and the loading actuator. The ECU is designed to receive the identifier of the delivery object and the delivery address. The ECU is further designed to control the power source and the steering actuator to move the main body through a warehouse to a location of the delivery object. The ECU is further designed to control the loading actuator to facilitate the movement of the delivery object onto the platform. The ECU is further designed to control the power source and the steering actuator to move the main body to the delivery address.

[0006] Also disclosed is a method for autonomously delivering one or more object. The method includes receiving, by an input device, an identifier of a leading vehicle. The method also includes determining, by an electronic control unit (ECU), a following time to begin following the leading vehicle. The method also includes detecting, by a tracking sensor, a location of a main body having a platform for supporting the one or more object relative to a leading vehicle. The method also includes controlling, by the ECU, a power source and a steering actuator to move the main body to follow the leading vehicle at the following time based on the detected location of the main body relative to the leading vehicle.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] Other systems, methods, features, and advantages of the present invention will be or will become apparent to one of ordinary skill in the art upon examination of the following figures and detailed description. It is intended that all such additional systems, methods, features, and advantages be included within this description, be within the scope of the present invention, and be protected by the accompanying claims. Component parts shown in the drawings are not necessarily to scale, and may be exaggerated to better illustrate the important features of the present invention. In the drawings, like reference numerals designate like parts throughout the different views, wherein:

[0008] FIG. **1** is a block diagram illustrating an autonomous workhorse vehicle designed to deliver and otherwise distribute objects according to an embodiment of the present invention;

[0009] FIG. **2** is an exemplary autonomous workhorse vehicle designed to travel on a ground surface according to an embodiment of the present invention;

[0010] FIG. **3** is an exemplary autonomous workhorse vehicle designed to travel on a ground surface according to an embodiment of the present invention;

[0011] FIG. **4** is an exemplary autonomous workhorse vehicle designed to travel through water according to an embodiment of the present invention;

[0012] FIG. **5** is an exemplary autonomous workhorse vehicle designed to travel through air according to an embodiment of the present disclosure; and

[0013] FIGS. **6**A and **6**B are flowcharts illustrating a method for controlling an autonomous workhorse vehicle according to an embodiment of the present disclosure.

DETAILED DESCRIPTION

[0014] The present disclosure describes systems and methods for facilitating delivery and other distribution of objects from a store or a warehouse. The systems and methods provide multiple benefits and advantages such as delivery of the objects from the store or the warehouse by an autonomous vehicle, advantageously saving the time of the purchaser or the user. The systems and methods also advantageously assist in loading and unloading the goods from the vehicle, making the loading and unloading easier for the purchaser or the user. The systems and methods also provide the benefit of allowing items to be returned to the vehicle rather than the store, saving a trip to the store by the purchaser or the user. The systems and methods also advantageously allow the user to load an old part, such as a broken appliance, onto the vehicle for delivery to a recycle plant or dump, again saving the user time. The systems and methods also provide the benefit of being usable as a kiosk such that they can make money for a store during hours in which the store is closed.

[0015] An exemplary system includes a main body having a platform for supporting an object. The system further includes a power source for powering the vehicle and a steering actuator for steering the vehicle. The system further includes a loading actuator to facilitate loading of the object onto the vehicle. The system also includes an input/output port that can receive user input directly from a user or from a remote device. The system also includes an electronic control unit (ECU). The ECU can control the power source and the steering actuator to maneuver the vehicle behind a leading vehicle or to a delivery address based on the received input. The ECU can also control the loading actuator to load or unload the object from the vehicle also based on the received input.

[0016] Turning to FIG. **1**, an autonomous workhorse vehicle **100** (or vehicle **100**) includes a system **101** for providing a platform for delivery and other distribution of objects. The vehicle **100** (or system **101**) may include an ECU **102**, a memory **104**, and a power source **106**. The vehicle **100** (or system **101**) may further include a main body **108** that includes a platform **110**. The vehicle **100** (or system **101**) may further include an input/output port **112**, a payment mechanism **114**, a power port **116**, a loading actuator **118**, a loading sensor **120**, a distribution actuator **122**, a distribution lock **124**, a tracking sensor **126**, and a steering actuator **128**.

[0017] The power source **106** may include any one or more of an engine **130**, a motor-generator **132**, a battery **134**, or a fuel-cell circuit **136**. The engine **130** may convert a fuel into mechanical power for propelling the main body **108**. In that regard, the engine **130** may be a gasoline engine, a diesel engine, a natural gas engine, or the like.

[0018] The battery **134** may store electrical energy. In some embodiments, the battery **134** may include any one or more energy storage devices including a battery, a flywheel, a super capacitor, a thermal storage device, or the like.

[0019] The fuel-cell circuit **136** may include a plurality of fuel cells that facilitate a chemical reaction to generate electrical energy. For example, the fuel cells may receive hydrogen and oxygen, facilitate a reaction between the hydrogen and oxygen, and output electricity in response to the reaction. In that regard, the electrical energy generated by the fuel-cell circuit **136** may be stored in the battery **134** and/or used by the motor-generator **132**. In some embodiments, the vehicle **100** may include multiple fuel-cell circuits including the fuel-cell circuit **136**.

[0020] The motor-generator **132** may convert the electrical energy stored in the battery **134** (or electrical energy received directly from the fuel-cell circuit **136**) into mechanical power usable to propel the vehicle **100**. The motor-generator **132** may further convert mechanical power received from the engine **130** or from wheels of the vehicle **100** into electricity, which may be stored in the battery **134** as energy and/or used by other components of the vehicle **100**. In some embodiments, the motor-generator **132** may include a motor without a generator portion and, in some embodiments, a separate generator may be provided.

[0021] The ECU **102** may be coupled to each of the components of the vehicle **100** and may include one or more processors or controllers, which may be specifically designed for automotive systems. The functions of the ECU **102** may be implemented in a single ECU or in multiple ECUs. The ECU **102** may receive data from components of the vehicle **100**, may make determinations based on the received data, and may control the operations of components based on the determinations.

[0022] The vehicle **100** may be fully autonomous or semi-autonomous. In that regard, the ECU **102** may control various aspects of the vehicle **100** (such as steering, braking, accelerating, or the like) to maneuver the vehicle **100**, for example, behind a leading person or vehicle, from a starting location to a destination location, or the like. The ECU **102** may further control the vehicle **100** to avoid collisions while the vehicle **100** is traveling.

[0023] The memory **104** may include any non-transitory memory and may be capable of storing data usable by the ECU **102**. For example, the memory **104** may store instructions usable by the ECU **102** to navigate the vehicle **100** from a starting location to a destination location, or the like. The memory **104** may store other data usable by the ECU **102** such as locations of objects to be purchased in a store or warehouse, a cost of various items stored on the platform **110**, one or more home location of the vehicle **100**, locations of one or more recycling or landfill site, or the like.

[0024] The main body **108** may resemble an automobile such as a car, a truck, a scooter, a boat, a jet ski, an aircraft, a golf cart, or the like. The platform **110** may include any platform capable of supporting at least one object. For example, the main body **108** may be pushed by a user through a store and items to be purchased or rented may be loaded on the platform **110**. As another example, the main body **108** may be maneuvered through a warehouse by a user or by the ECU **102**, and the loading actuator **118** may load items onto the platform **110**. The ECU **102** may then control the vehicle **100** to follow a personal vehicle of a user (or to travel alone) to a location at which the objects will be unloaded and may then control the vehicle **100** to return to the home location.

[0025] The input/output port **112** may include any port capable of at least one of receiving data or outputting data.

For example, the input/output port **112** may include an input device such as a keyboard, a touchscreen, a microphone, or the like. As another example, the input/output port may include an output device such as a display, a touchscreen, a speaker, or the like. As yet another example, the input/output port may include a port capable of communicating with a remote device via a wired or wireless interface, such as via Bluetooth, Wi-Fi, FireWire, Ethernet, or the like.

[0026] The payment mechanism **114** may include any mechanism capable of receiving payment for a rental or a purchase. For example, the payment mechanism **114** may include a physical payment mechanism such as a credit card reader or a cash receiving slot, or may include a port capable of receiving payment information such as Apple pay or the like.

[0027] The power port **116** may be coupled to the power source **106** and may at least one of receive or output electrical power. For example, a cable may be coupled to the power port **116** and to an external power source and power may be provided from the external power source to charge the battery **134**. As another example, a cable may be coupled to the power port **116** and to a device located on the platform **110** and used to charge the device on the platform **110**. As another example, a cable may be coupled to the power port **116** and to an electronic tool, and power from the battery **134** may be used to power the electronic tool. As yet another example, the power port **116** may transmit and/or receive wireless power. In that regard, a device may be located on the platform **110** and the device may receive electrical power wirelessly from the power port **116**.

[0028] The loading actuator **118** may include any actuator capable of facilitating at least one of loading an object onto the platform **110** or unloading an object from the platform **110**. For example, the loading actuator **118** may include any one or more actuator coupled together to form part of a robot arm, may extend a slide upward from the platform **110** to facilitate loading an object onto the platform **110** or extend a slide downward from the platform **110** to facilitate unloading an object from the platform **110**, or the like.

[0029] The loading sensor **120** may include any one or more sensor capable of detecting whether one or more objects has been loaded onto the platform **110** or removed from the platform **110**. For example, the loading sensor **120** may include a pressure sensor located on the platform **110**, an inductive sensor capable of detecting the presence of an object on the platform **110**, a wireless communication port capable of communicating with a wireless port (such as a radio frequency ID (RFID) tag) of an object to determine whether the object has been placed on the platform **110** or removed from the platform **110**, or the like.

[0030] The distribution actuator **122** may facilitate movement of an object for sale or for rent from the platform **110** to a location away from the platform **110**. For example, the distribution actuator **122** may actuate an item that is for sale from a location inside a locked unit to a location outside of the locked unit. As another example, the distribution actuator **122** may include a robot arm that moves an object from a locked or restricted location to another location from which the object may be retrieved. For example, one or more object may be available to rent from the vehicle **100** (a rental object) or one or more objects may be available for purchase from the vehicle **100** (a for sale object). The ECU **102** may receive a request to rent or purchase the object via the input/output port **112**, may determine that payment has been received for the object via the payment mechanism **114**, and may control the distribution actuator **122** to release the object.

[0031] The distribution lock **124** may include any lock or other mechanism that restricts release of an object from the platform **110**. For example, the distribution lock **124** may include a case or other locking element that restricts release of the object from the platform **110**. The ECU **102** may receive a request to rent or purchase the object via the input/output port **112**, may determine that payment has been received for the object via the payment mechanism **114**, and may control the distribution lock **124** to release the object.

[0032] The tracking sensor **126** may include any one or more sensor capable of detecting a location of an object (such as a leading vehicle or a leading person) relative to the main body **108**. For example, the tracking sensor **126** may include a proximity sensor, a camera, a Bluetooth or Wi-Fi port (to determine the relative location of another Bluetooth or Wi-Fi enabled device), or the like.

[0033] The steering actuator **128** may be coupled to one or more wheel of the vehicle **100** and may be actuated by the ECU **102** to control steering of the vehicle **100**.

[0034] The vehicle **100** may be used to ease shopping burdens of a user. In some situations, the vehicle **100** may be stored at a store or warehouse. A user may indicate his desire for the vehicle **100** to follow the user as the user is shopping in the store. In that regard, the ECU **102** may control the power source **106** and the steering actuator **128** to follow the user based on a relative location of the user as detected by the tracking sensor **126**. The user may load items onto the platform **110**. In some situations, the user may load the platform **110** after the user has completed shopping by moving items from a shopping cart onto the platform **110**. In some embodiments, the loading actuator **118** may be controlled (such as by the ECU **102** or by input(s) received from the input/output port **112**) to facilitate movement of the object or objects onto the platform **110**.

[0035] Rather than rent a truck that the user may drive to deliver the object or objects and then return the truck and drive home in the personal vehicle of the user, the vehicle **100** may be designed to autonomously drive to a received destination location, or to follow the personal vehicle of the user based on the relative location as detected by the tracking sensor **126**. In that regard, after the user has paid for the purchased items (via the payment mechanism **114** or at a payment kiosk or cash register) the ECU **102** may control the vehicle **100** to travel to the destination location or to follow the personal vehicle of the user to the destination location. In some embodiments, the user may indicate to the vehicle **100** when it is ready for the vehicle **100** to follow the personal vehicle of the user. For example, the user may provide such indication via the input/output port **112**, and the user may provide an identification of his or her personal vehicle.

[0036] In some embodiments, a user may remotely purchase one or more objects using a remote device (such as a computer or mobile phone) and the purchase may be received via the input/output port **112**. The ECU **102** may control the vehicle **100** to travel through a warehouse, and may control the loading actuator **118** to load each of the purchased objects onto the platform **110**. After all objects have been loaded onto the platform **110**, the ECU **102** may control the vehicle **100** to travel to the destination location.

The destination location may include, for example, a business, a worksite, a preparation site (such as a professional shop), a home, or the like.

[0037] Once at the destination location, the user may unload the object or objects from the platform **110**. In some embodiments, the ECU or the user may control the loading actuator **118** to unload the objects from the platform **110**. The loading sensor **120** may detect when each of the objects has been removed from the platform **110**. After the objects have been removed from the platform **110**, the ECU **102** may control the vehicle **100** to return to the starting location (e.g., the warehouse) or to the next delivery address.

[0038] In some embodiments, the vehicle **100** may be shared by several stores. In that regard, the stores may indicate when the vehicle is desired, and the ECU **102** may control the vehicle **100** to travel to the next store at which it is desired.

[0039] In some embodiments, the vehicle **100** may travel with one or more objects on the platform **110** that are available for purchase or rent. For example, the vehicle **100** may travel with umbrellas or groceries for sale. If the vehicle **100** is not required or desired at any specific location (or if it is after hours) the ECU **102** may control the vehicle **100** to travel to a location at which the objects for sale are desired (such as a street corner in the rain). In that regard, the vehicle **100** may operate as a vending machine for the objects that are for sale.

[0040] The rental objects may include tools usable to install various objects. For example, the rental objects may include drills, hammers, screwdrivers, or the like. In that regard, as a user is installing an object that has been delivered, the user may indicate a desire to rent one or more tools, may pay for the rental via the payment mechanism **114**, and the ECU **102** may control one or both of the distribution actuator **122** or the distribution lock **124** to release the rental objects from the platform **110**.

[0041] In some embodiments, additional power may be required or desired at the destination location. In that regard, a user may connect one or more devices from which power is desired to the power port **116**. The power port **116** may provide the power (such as from the battery **134**, the fuel-cell circuit **136**, or the motor-generator **132**) to power the one or more devices. In some embodiments, the vehicle **100** may function as a home generator. In that regard, a user may connect an outlet at their home to the power port **116** and the power from the vehicle **100** may power one or more component of the home.

[0042] The vehicle **100** may provide additional features such as an air compressor, a dolly, a nail gun, or other tools that are useful for various projects or repairs. Such additional features may be available for rent, or such additional features may be provided free of charge.

[0043] The vehicle **100** may be capable of traveling off-road, through the air, on a road, or through water. In that regard, the vehicle **100** may operate as a land-based vehicle, an off-road vehicle, an aircraft, a watercraft, or the like.

[0044] A user may load an old object (such as a refrigerator that is being replaced) onto the platform **110** after the new object (such as a new refrigerator) has been removed from the platform **110**. In some embodiments, the loading actuator **118** may facilitate loading of the old object onto the platform **110**. In such embodiments, the ECU **102** may control the vehicle **100** to travel to a dumpsite or a recycling site to dump or recycle the old object.

[0045] In some embodiments, it may be desirable for the vehicle **100** to pick up professional workers in addition to picking up one or more objects for sale. For example, it may be desirable to pick up workers to assist in installing a deck or other home component, or to assist in providing home repair. In that regard, a user may request that one or more professionals travel with the object or objects to help with such installation or repair. The ECU **102** may control the vehicle **100** to travel to a location to pick up the one or more professionals prior to traveling to the destination location if such a request has been made.

[0046] In some embodiments, a user may sign up for a service in which specific objects are delivered in certain situations. For example, the user may request to rent a generator each time power goes out for more than a specified time (e.g., 15 minutes) in a certain area. In that regard, each time the power goes out, the ECU **102** may learn of such power outage. The ECU **102** may in turn control the vehicle **100** to pick up a generator and take the generator to the house of the individual so the individual can rent the generator until power is restored. Upon restoration of power, the ECU **102** may control the vehicle **100** to pick up the generator from the house of the individual and return it to its original location or to a new location.

[0047] The vehicle **100** may also be used to help individuals move between locations. In that regard, the vehicle **100** may be rented, may show up at the old location of the user, and may be loaded at the old location of the user. The vehicle **100** may then be programmed to depart from the old location of the user and travel to the new location of the user. The vehicle **100** may then be unloaded, and may return itself to the starting location or a new location, as desired.

[0048] In some embodiments, a user may wish to return one or more part, such as if it is damaged or is an incorrect part. For example, a user may purchase a handful of various screws, not knowing which one is correct. Upon learning which product or products are correct, the user may wish to return the remaining products. In that regard, the user may provide an indication of which products are being returned (such as via the input/output port **112**) via the loading sensor **120** may detect the return of these parts, and the ECU **102** may issue a credit to an account associated with the user for the returned products.

[0049] In some embodiments, various vehicles similar to the vehicle **100** may be provided that have differing sizes. For example, the vehicle **100** may be provided in two sizes, three sizes, four sizes, or the like. A user may select a desired model of the vehicle **100** based on which product or products are being purchased or otherwise moved. Pricing for rental of the vehicle **100** may vary based on the desired model. Additionally, different models may include different features. For example, some models may provide a power port and others may not, some may provide an air compressor, and the like.

[0050] The vehicle **100** may be requested by a user in any of multiple manners. For example, the user may request to rent the vehicle **100** in a store, the vehicle may be requested online or in an app, or the like.

[0051] In some embodiments, a user may load a shopping cart or a dolly with objects in the store and may load the entire shopping cart or dolly onto the platform **110** of the vehicle **100**. The vehicle **100** may then deliver the goods, including the shopping cart or dolly, to ease unloading of the goods.

[0052] Turning now to FIG. **2**, an autonomous workhorse vehicle **200**, or vehicle **200**, may include similar features as the vehicle **100** of FIG. **1**. In particular, the vehicle **200** may have a main body **202** that includes a platform **204** capable of supporting one or more objects. The vehicle **200** may include a pressure sensor **206** that functions as a loading sensor by detecting the presence of one or more object **210** on the platform **204**.

[0053] The vehicle **200** may further include a robot arm **208** as a loading actuator. The robot arm **208** may facilitate movement of the object **210** onto the platform **204** and off of the platform **204**.

[0054] The vehicle **200** may further include a sales kiosk **212**. The sales kiosk **212** may function as a distribution lock and may enclose one or more rental product or for sale product **218** therein. The sales kiosk **212** may include a payment mechanism **216** capable of receiving cash or a credit card. Upon payment for a rental product or for sale product, a distribution actuator **214** may actuate a rental product or for sale product **218** out of the sales kiosk **212** where it may be retrieved by a purchaser.

[0055] The vehicle **200** may communicate with a remote device **220**. The remote device **220** may be used, for example, to request rental of the vehicle **200**, to provide a delivery address for the object **210**, to indicate when the object **210** has been removed from the platform **204**, to provide a delivery time at which the objects are desired to be delivered, or the like. For example, the remote device **220** may be a mobile phone, a laptop, or the like, and may communicate with the vehicle **200** via a wired or wireless protocol.

[0056] Turning now to FIG. **3**, another vehicle **300** has similar features as the vehicle **100** of FIG. **1**. In particular, the vehicle **300** has a main body **302** that includes a platform **304** for supporting a plurality of objects **314**. The vehicle **300** further includes an inductive charging pad **306** and a touchscreen **308**. The inductive charging pad **306** may provide a wireless charge to wirelessly charge batteries of the objects **314**. The touchscreen **308** may function as an input device and an output device, and may be used to input a destination address or location, control a loading actuator **312**, or the like.

[0057] The vehicle **300** may further include a power port **310** and the loading actuator **312**. The power port **310** may output power usable to power one or more electric tools or to power other devices as desired. The loading actuator **312** may be raised in order to load the objects **314** onto the platform **304**, and lowered in order to unload the objects **314** from the platform **304**.

[0058] Referring now to FIG. **4**, another vehicle **400** includes similar features as the vehicle **100** of FIG. **1**. In particular, the vehicle **400** includes a main body **402** that is designed to float in water. The main body **402** includes a platform **408** onto which one or more object **406** may be loaded.

[0059] The vehicle **400** further includes a power source **404** which may be used to propel the vehicle **400** through water. For example, the power source **404** may include an engine and a propeller.

[0060] Referring now to FIG. **5**, another vehicle **500** includes similar features as the vehicle **100** of FIG. **1**. In particular, the vehicle **500** includes a main body **502** that is designed to fly through the air. The main body **502** includes a platform **504** onto which one or more object may be loaded. In some embodiments, the one or more objects may be suspended from the platform **504** rather than placed on a top surface of the platform **504**. In that regard, where used in this context, a platform may support an object in any manner.

[0061] The vehicle **500** may further include a power source **506** that includes two to four (or more) motors and propellers. The motors and propellers may be used to propel the vehicle **500** through air. In some embodiments, the vehicle **500** may include any quantity of motors and propellers, may include one or more engine, or the like. Although shown as a copter configuration, the vehicle **500** may instead have a configuration similar to an airplane.

[0062] Referring now to FIGS. **6**A and **6**B, a method **600** may be performed by a vehicle similar to any of the vehicles **100**, **200**, **300**, **400**, or **500**. In block **602**, an ECU of the vehicle may receive an identifier of one or more delivery objects. For example, an input device of the vehicle may receive the identifier from a user at a store. As another example, a user may request one or more delivery objects using a remote device, and the list of delivery objects may be transferred to an input/output port of the vehicle.

[0063] The vehicle may include a map of a store or warehouse in which it is located that includes locations of various objects. In block **604**, the vehicle may travel through a warehouse or store to the locations of the one or more delivery objects that was received in block **602**. In some embodiments, the vehicle may travel through a store with a user. In that regard and in block **606**, the ECU may control the vehicle to follow a leading person through the warehouse or store. For example, as the user enters the store, the user can indicate that the vehicle should follow the user through the store. The vehicle may determine the relative location of the leading person and may use that relative location to follow the leading person through the store.

[0064] In block **608**, the ECU may control a loading actuator to facilitate movement of the one or more delivery objects onto a platform of the vehicle. For example, a user may point to the delivery object or may otherwise indicate the identity of the delivery object. Based on the stored map or the input from the user, the ECU may control the loading actuator to facilitate movement of the delivery object onto the platform. In some embodiments, a user may simply request that the loading actuator extend to facilitate movement of the delivery object onto the platform, and the user may place the delivery object onto the platform.

[0065] In block **610**, the ECU of the vehicle may receive a pickup request corresponding to a request to pick up an individual between the store and warehouse at the destination location. For example, the pickup request may be provided by a user. In some embodiments, the pickup request may simply indicate a type of labor that is requested and the ECU may be programmed to go to a specific location associated with the type of labor. In some embodiments, the pickup request may include an address of the person or people to be picked up and the ECU may control the vehicle to travel to the address or destination location. The pickup request may include a time at which the individual is to be picked up. For example, the pickup request may include the address and time, and the ECU will control the vehicle to be at the address at a time near the pickup time (e.g., within 10 minutes of the pickup time, or within 30 minutes of the pickup time, or within an hour of the pickup time).

[0066] In block **612**, the ECU may control the power source and the steering actuator of the vehicle to travel to the destination location of the individual that was received in block **610**. In some embodiments, after the individual has entered the vehicle, the individual may use an input device to indicate that he or she has entered the vehicle. In some embodiments, the vehicle may include a sensor capable of detecting when the individual has entered the vehicle.

[0067] In block **614**, the ECU may control the vehicle to follow a leading vehicle or to travel to a previously provided destination location. The ECU may be provided with information regarding whether to follow a leading vehicle or whether to travel to a destination location. For example, a user may provide input to the ECU regarding this decision. If the vehicle has been previously provided with a list of delivery objects to be delivered then the ECU may know to simply travel to the address after the delivery objects have been loaded onto the platform. If the ECU is following a user around the store, the user may indicate whether the vehicle should followed the leading vehicle or travel to the delivery address without following the leading vehicle.

[0068] In some embodiments, the ECU may be provided with a delivery time. For example, when placing an order, or paying at a store, a user may provide a time at which he or she desires the delivery objects to be delivered. The ECU may predict an amount of time that it will take to get to the delivery address and may cause the vehicle to depart its location at a time of day which allows the vehicle to reach the delivery address at the delivery time. For example, the ECU may cause the vehicle to depart at a time which will cause the vehicle to reach the delivery address within a predetermined amount of time of the delivery time such as 10 minutes, 15 minutes, 30 minutes, an hour, or the like of the delivery time. The predetermined amount of time may correspond to an amount of time which is considered reasonable for a delivery to be early or late.

[0069] In block **616**, while the vehicle is traveling from the store or warehouse to the pickup address or the destination address, the ECU may control a power port of the vehicle to charge a battery of one or more delivery objects, sale objects, or rental objects that are to be loaded on the platform. For example, the ECU may be capable of receiving or otherwise determining a power level of each object on the platform. The ECU may charge the battery of each object based on the determined power level and based on the delivery address and order of each object. For example, the ECU may first charge objects that will be delivered first, may charge objects having the lowest power level first, or the like. The ECU may charge each object until the power level reaches or exceeds a predetermined threshold power level that corresponds to a minimum desirable amount of charge.

[0070] In block **618**, the ECU may control the loading actuator to facilitate movement of the one or more delivery objects off of the platform at the destination location. This control may be based on a request from the user, may be determined by the ECU based on the specific destination address and a list of items to be delivered at the destination address, or the like. This unloading of the one or more delivery object may be performed in a similar manner as the loading in block **608**.

[0071] In block **620**, the ECU may receive a rent request corresponding to a request for a user to rent a rental object, or a purchase request corresponding to a request for a user to purchase a for sale object. The rent request or the purchase request may be received via an input device of the vehicle, or may be received from a user device of the user. For example, the rent request or the purchase request may be received while at a delivery address, or may be received while the vehicle is at another location, such as a street corner, a parking lot, or the like.

[0072] In block **622**, the vehicle may receive payment for the rental or the for sale object. For example, the payment may be received by a payment mechanism and may include receipt of cash, insertion or swiping of a credit card, or payment via another means of payment such as Apple pay.

[0073] In block **624**, the ECU may control a distribution lock to unlock the rental object or the for sale object, or may control a distribution actuator to distribute the rental object or the for sale object. For example, the ECU may control the unlocking or distribution of the rental object or the for sale object after receiving the rent request and after determining that payment has been received for the rental object or the for sale object.

[0074] In block **626**, the vehicle may receive a return message indicating that one or more objects are being returned. For example, the message may indicate that a rental object is being returned, that a delivery object is being returned, or that a for sale object is being returned. The message may be received via an input device of the vehicle, may be received from a remote device, or the like. In some embodiments, a user may place the item to be returned in a specific location on the platform and the ECU may determine that the item is being returned based on the placement on the platform.

[0075] In block **628**, a sensor may detect that the object being returned has been placed on the platform. In some embodiments, the ECU may control a loading actuator to load the object onto the platform. After facilitating movement of the object onto the platform or detecting that the object has been placed on the platform, the ECU may issue a credit for the returned object in block **630**. For example, the ECU may issue a credit to an account associated with the user who is returning the object.

[0076] In block **632**, the ECU may receive an old part return request corresponding to a request to return an old part. For example, the old part may include a refrigerator, a microwave, broken planks, or the like to be delivered to a recycling plant or a landfill. The old part return request may be received by an input device of the vehicle or may be received from a remote device of a user. In some embodiments, the old part return request may be received at the time a purchase request is received such that the user can ensure that room exists on the platform for the old part to be loaded thereon.

[0077] In block **634**, the ECU may control a loading actuator to facilitate movement of the old part onto the platform. For example, the loading actuator may physically maneuver the old part onto the platform or may otherwise facilitate loading of the old part onto the platform.

[0078] In block **636**, the vehicle may provide power for tools while at the destination location. For example, a user may request power to be provided and may plug in the device into a power port of the vehicle. In some embodiments, the ECU may charge a specific amount of money per unit of time that power is used, or per unit of power. In that regard, the ECU may keep track of the amount of time that

power is used or the amount of power that is used and may debit an account associated with the user for the use of power.

[0079] In block **638**, a sensor may detect removal of the delivery object or the vehicle may receive input indicating that the delivery object has been removed from the platform. For example, the sensor may include a pressure sensor, an inductive sensor, a camera, a radar sensor, a LIDAR sensor, or the like.

[0080] In block **640**, the vehicle may return to the store or the warehouse, may travel to a new destination for delivery or sales at the new destination, or may travel to a recycling plant or dump for unloading of an old part. For example, if the vehicle is requested at a store and has been unloaded, the ECU may control the vehicle to return to the store. As another example, if additional delivery objects are located on the vehicle, the vehicle may travel to the delivery address of the additional delivery objects. If it is after hours, the vehicle may travel to a location at which it may continue to sell or rent parts. If the vehicle has been loaded with an old part, the ECU may be aware of whether the old part should be recycled or taken to a dump, and may control the vehicle accordingly.

[0081] Where used throughout the specification and the claims, "at least one of A or B" includes "A" only, "B" only, or "A and B." Exemplary embodiments of the methods/systems have been disclosed in an illustrative style. Accordingly, the terminology employed throughout should be read in a non-limiting manner. Although minor modifications to the teachings herein will occur to those well versed in the art, it shall be understood that what is intended to be circumscribed within the scope of the patent warranted hereon are all such embodiments that reasonably fall within the scope of the advancement to the art hereby contributed, and that that scope shall not be restricted, except in light of the appended claims and their equivalents.

What is claimed is:

1. An autonomous workhorse vehicle comprising:

a main body including a platform configured to support a plurality of objects;

a tracking sensor configured to detect a location of the main body relative to a leading vehicle;

an input/output port configured to receive an identifier of the leading vehicle;

a power source configured to provide power to propel the main body;

a steering actuator configured to adjust an orientation of the main body; and

an electronic control unit (ECU) coupled to the tracking sensor, the input/output port, the power source, and the steering actuator and configured to:

receive the identifier of the leading vehicle,

determine a following time to begin following the leading vehicle, and

control the power source and the steering actuator to move the main body to follow the leading vehicle at the following time based on the detected location of the main body relative to the leading vehicle.

2. The autonomous workhorse vehicle of claim **1** wherein:

the input/output port is further configured to receive user input indicating that the main body is to follow a leading person;

the tracking sensor is further configured to detect a location of the main body relative to the leading person; and

the ECU is further configured to control the power source and the steering actuator to move the main body to follow the leading person in response to the input/output port receiving the user input based on the detected location of the main body relative to the leading person.

3. The autonomous workhorse vehicle of claim **1** further comprising a loading actuator configured to facilitate movement of at least one of the plurality of objects onto the platform, wherein:

the input/output port is further configured to receive a user request to facilitate the movement of the at least one of the plurality of objects onto the platform; and

the ECU is further configured to control the loading actuator to facilitate the movement of the at least one of the plurality of objects onto the platform in response to the input/output port receiving the user request.

4. The autonomous workhorse vehicle of claim **1** further comprising a loading actuator configured to facilitate movement of at least one of the plurality of objects onto the platform, wherein:

the input/output port is configured to receive a list of the plurality of objects from a remote device; and

the ECU is configured to control the power source and the steering actuator to move the main body through a warehouse to locations of each of the plurality of objects and to control the loading actuator to facilitate the movement of each of the plurality of objects onto the platform in response to the input/output port receiving the list of the plurality of objects.

5. The autonomous workhorse vehicle of claim **1** further comprising a loading sensor configured to detect whether each of the plurality of objects has been removed from the platform, wherein the ECU is further configured to control the power source and the steering actuator to cause the main body to return to a home location in response to the loading sensor detecting that each of the plurality of objects has been removed from the platform.

6. The autonomous workhorse vehicle of claim **1** further comprising:

a payment mechanism configured to receive payment; and

a distribution actuator configured to actuate at least one of the plurality of objects from the platform to a location away from the platform,

wherein the ECU is further configured to:

determine that the payment mechanism has received the payment,

receive a request to purchase the at least one of the plurality of objects from the input/output port, and

cause the distribution actuator to actuate the at least one of the plurality of objects from the platform to the location away from the platform in response to determining that the payment mechanism has received the payment and in response to receiving the request to purchase the at least one of the plurality of objects.

7. The autonomous workhorse vehicle of claim **1** wherein the main body is configured to at least one of travel along a ground surface, travel through air, or travel on a body of water.

8. The autonomous workhorse vehicle of claim 1 wherein the input/output port is configured to receive a return message from a user device indicating that at least one of the plurality of objects is being returned, and the ECU is further configured to generate a credit to an account associated with the user device in response to receiving the return message.

9. An autonomous workhorse vehicle comprising:

a main body including a platform configured to support a plurality of objects;

an input/output port configured to receive an identifier of a delivery object to be delivered from a remote device and a delivery address corresponding to an address at which the delivery object is to be delivered;

a power source configured to provide power to propel the main body;

a steering actuator configured to adjust an orientation of the main body;

a loading actuator configured to facilitate movement of the delivery object onto the platform; and

an electronic control unit (ECU) coupled to the input/output port, the power source, the steering actuator, and the loading actuator and configured to:

receive the identifier of the delivery object and the delivery address,

control the power source and the steering actuator to move the main body through a warehouse to a location of the delivery object,

control the loading actuator to facilitate the movement of the delivery object onto the platform, and

control the power source and the steering actuator to move the main body to the delivery address.

10. The autonomous workhorse vehicle of claim 9 further comprising:

a payment mechanism configured to receive payment; and

a distribution lock configured to retain a rentable object in place on the platform,

wherein the ECU is further configured to:

receive a rent request corresponding to a request to rent the rentable object from the input/output port,

determine that the payment mechanism has received the payment, and

cause the distribution lock to release the rentable object in response to receiving the rent request and in response to determining that the payment mechanism has received the payment.

11. The autonomous workhorse vehicle of claim 9 further comprising a loading sensor configured to detect when the delivery object has been removed from the platform, wherein the ECU is further configured to control the power source and the steering actuator to cause the main body to at least one of return to a home location or travel to a new delivery address in response to the loading sensor detecting that the delivery object has been removed from the platform.

12. The autonomous workhorse vehicle of claim 9 further comprising:

a payment mechanism configured to receive payment; and

a distribution actuator configured to actuate a for sale object of the plurality of objects from the platform to a location away from the platform,

wherein the ECU is further configured to:

receive the payment from the payment mechanism,

receive a request to purchase the for sale object from the input/output port, and

cause the distribution actuator to actuate the for sale object from the platform to the location away from the platform in response to receiving the payment and the request to purchase the for sale object.

13. The autonomous workhorse vehicle of claim 9 wherein the input/output port is configured to receive a return message from a user device indicating that the delivery object is being returned, and the ECU is further configured to generate a credit to an account associated with the user device in response to receiving the return message.

14. The autonomous workhorse vehicle of claim 9 wherein:

the input/output port is further configured to receive an old part return request corresponding to a request to return an old part; and

the ECU is further configured to control the loading actuator to facilitate loading the old part onto the platform.

15. The autonomous workhorse vehicle of claim 9 wherein the input/output port is further configured to receive a pickup request corresponding to a request to pick up an individual and including a pickup address, and the ECU is further configured to control the power source and the steering actuator to move the main body to the pickup address to pick up the individual prior to the delivery address.

16. The autonomous workhorse vehicle of claim 9 wherein the delivery object is a generator configured to convert fuel into electricity, the input/output port is configured to receive a power indicator indicating that electrical power is unavailable at the delivery address, and the ECU is configured to control the power source and the steering actuator to move the main body to the delivery address in response to the input/output port receiving the power indicator.

17. The autonomous workhorse vehicle of claim 9 wherein the delivery object includes a battery, and the ECU is further configured to control the power source to charge the battery of the delivery object while the main body is traveling to the delivery address.

18. The autonomous workhorse vehicle of claim 9 wherein:

the input/output port is further configured to receive a delivery time corresponding to a time of day at which delivery is desired; and

the ECU is further configured to control the power source and the steering actuator to cause the main body to reach the delivery address within a predetermined amount of time of the delivery time.

19. A method for autonomously delivering one or more object, comprising:

receiving, by an input device, an identifier of a leading vehicle;

determining, by an electronic control unit (ECU), a following time to begin following the leading vehicle;

detecting, by a tracking sensor, a location of a main body having a platform for supporting the one or more object relative to a leading vehicle; and

controlling, by the ECU, a power source and a steering actuator to move the main body to follow the leading vehicle at the following time based on the detected location of the main body relative to the leading vehicle.

20. The method of claim **19** further comprising:

receiving, by the input/output port, user input indicating that the main body is to follow a leading person;

detecting, by the tracking sensor, a location of the main body relative to the leading person; and

controlling, by the ECU, the power source and the steering actuator to move the main body to follow the leading person in response to the input/output port receiving the user input based on the detected location of the main body relative to the leading person.

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